Zonate Leaf Spot of Indian Jujube Caused by *Cristulariella moricola*

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ABSTRACT

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Zonate leaf spot of Indian jujube, *Zizyphus mauritiana*, in Taiwan was found to be caused by *Cristulariella moricola*. Leaves of *Cinnamomum camphor, Bauhinia purpurea, Morus australis*, and *Ficus septica* inoculated with *C. moricola* also developed zonate leaf spots. Disease development on detached leaves and growth of the pathogen were favored by temperatures of 16–25 C.

Indian jujube (*Zizyphus mauritiana* Lam.) is grown in the tropical region of Taiwan, where it provides one of the popular fresh fruits for local consumption from January to April. In autumn 1969, a previously unreported zonate leaf spot of Indian jujube was noticed in several orchards (5). The disease was consistently associated with a fungus producing whitish macroscopic conical fruiting structures on diseased tissues. We report the cause of this disease. A preliminary report of this work has been published (5).

MATERIALS AND METHODS

Diseased leaf tissue obtained from the advancing margins of lesions was surface-sterilized in 1% NaOCl solution for 5 min, then plated on potato-dextrose agar. Mycelia and conidiophores were produced by growing the fungus on potato-dextrose agar and autoclaved Indian jujube leaves, respectively, at 19 C for 11 days. Detached leaves were surface-sterilized in 1% NaOCl solution for 5 min and placed in sterile petri plates, each containing a moistened filter paper. A conidiophore or a 1-mm^3 cube of mycelium plus agar cut from the agar culture was placed on the center of the leaf. Inoculated leaves were incubated at 19 C.

The effect of temperature on mass growth of *C. moricola* was determined in 50 ml of potato-dextrose broth. The broth was inoculated with a 2-mm disk of agar cut from the advancing margin of the colony. After incubation for 11 days, the mycelial mass was transferred to a filter paper, dried at 80 C for 24 hr, and weighed. The effect of temperature on linear growth was determined by measuring the colony diameter on potato-dextrose agar after incubation for 7 days.

The same isolate was used for pathogenicity tests and growth measurements. Five replicates were used for each treatment and the experiments were repeated at least twice.

RESULTS AND DISCUSSION

Symptoms and signs. The zonate lesions on Indian jujube leaves in the field were similar to those described on maple (6), pecan (3), and other hosts (1). Both surfaces of a lesion were brown with grayish concentric rings (Fig. 1A) and ranged from 2 to 20 mm in diameter. White to yellowish conical fruiting structures and sclerotial initials were produced on diseased tissues during periods of temperatures below 20 C and high humidity (Fig. 1B). The disease caused premature defoliation of infected trees. Black sclerotia of irregular shape were produced on leaves on the ground.

Pathogenicity. A fungus producing irregular black sclerotia (2–3 mm diam.) on potato-dextrose agar and conidiophores on autoclaved Indian jujube leaves was consistently isolated from diseased tissues. The dimensions of the conical heads were 106–266 × 306–625 μm. Microconidia were globose and hyaline and 2.5–4.0 μm in diameter. Morphological characteristics of the fungus were indistinguishable from those of *Cristulariella moricola* (Hino) Redhead (= *C. pyramidalis* Waterman & Marshall) (4,6). All Indian jujube leaves inoculated with mycelium or a conidiophore at 19 C developed brown spots with concentric rings and conidiophores similar to the leaf spots observed in the orchard. None of the control leaves developed symptoms. *C. moricola* was reisolated from the

Table 1. Effect of temperature on pathogenicity of *Cristulariella moricola* on detached Indian jujube leaves and on its growth in potato-dextrose broth and on potato-dextrose agar

Temperature (C)	Infection[a] (%)	Growth: Dry weight[b] (mg)	Growth: Colony diameter[c] (mm)
13	60	75	39
16	100	355	44
19	100	351	42
22	80	300	35
25	60	271	20
28	0	31	9
31	0	31	0
34	0	26	0

[a] Values are means of five replicates. Data were recorded 5 days after inoculation.
[b] Values are means of five replicates. Data were recorded after incubation for 11 days.
[c] Values are means of five replicates. Data were recorded after incubation for 7 days.

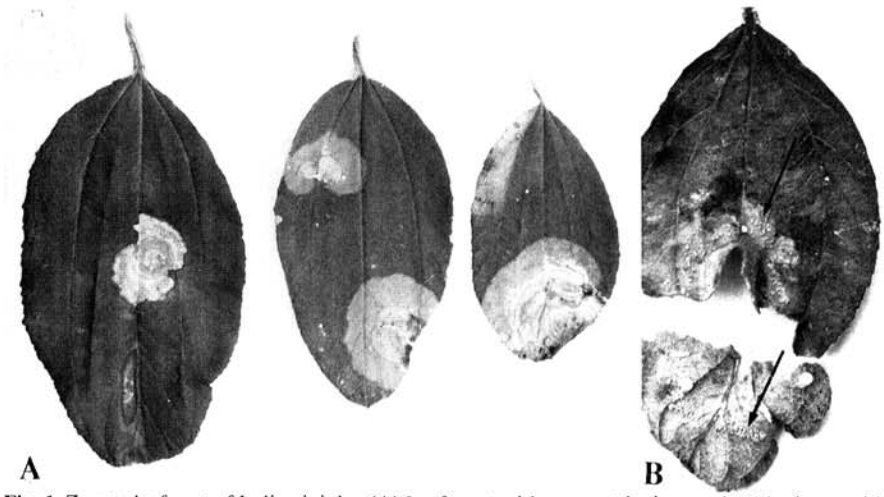

Fig. 1. Zonate leaf spot of Indian jujube. **(A)** Leaf spots with concentric rings and **(B)** leaf spot with conidiophores (arrow) and sclerotial initials (white particles).

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advancing margins of all artificially inoculated leaves, thus establishing its pathogenicity. Detached leaves of *Cinnamomum camphora* (L.) J. Preslo, *Bauhinia purpurea* L., *Morus australis* Poir., and *Ficus septica* Burm. inoculated with conidiophores of *C. moricola* also developed zonate leaf spots.

Infection of Indian jujube leaves by *C. moricola* occurred at 13–25 C but not at 28–34 C (Table 1). Increase of mycelial mass in potato-dextrose broth was most rapid at 16–25 C. Growth was slow at 13 and 28–34 C. Linear growth was most rapid at 13–22 C. The fungus did not grow on potato-dextrose agar at 31 and 34 C. Agar is capable of reducing availability of certain substances to fungi (2). This may explain growth of *C. moricola* in potato-dextrose broth but not on potato-dextrose agar at 31 and 34 C. Results show that low temperatures are favorable for disease development and pathogen growth.

Yokoyama and Tubaki (7) considered *Sclerotinia moricola* Hino, associated with zonate leaf spot of *Morus bomycis* Koidz. in Japan, and *Sclerotium cinnamomi* Sawada, associated with zonate leaf spots of *C. camphora, B. purpurea*, and *F. septica* in Taiwan, as synonyms of *C. pyramidalis*, which was subsequently replaced by *C. moricola* (4).

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